Zero mode of QFT and superluminal signalling in relativistic quantum information

By
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Abstract
In this presentation we will see how the “zero mode” of a quantum field --- that is, the constant component of the Fourier series decomposition of the field --- which arises when certain boundary conditions are imposed, can lead to superluminal signaling (causality violation) when it is ignored during quantization. This phenomenon can be operationally understood by coupling two spacelike-separated detectors (“atoms”) to the quantum field and see how their transition probabilities influence one another.

In this presentation we will first review the theoretical minimum of quantum field theory for a massless scalar field and motivate operational approach of understanding quantum field using particle detectors known technically as Unruh-DeWitt model. We will then use this model to understand the zero-mode problem. Background knowledge in special relativity, quantum mechanics and electromagnetism is desirable but it is hoped that the basic ideas of the presentation are accessible to general physics undergraduates.

Short Biography
Erickson Tjoa is currently a master’s student in Physics at the University of Waterloo. He graduated from PAP in August 2017 with BSc. (Hons) in Physics with second major in Mathematical Sciences.
During his fourth year, he visited University of Waterloo to pursue overseas final year project, a pilot program from NTU CN Yang Programme. There he worked on thermodynamics of Lovelock black holes using a framework which treats cosmological constant as thermodynamic variable. He is currently working on a relatively young field of relativistic quantum information.